AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of the claims in the application:

1. (Previously Presented) A rate control method, comprising, for a sequence of video data:

determining, via a video coder, a target bitrate for a picture in the sequence based on an estimate of the picture's complexity,

generating, via the video coder, a first quantizer estimate for the picture based on a fullness indicator from a transmit buffer of a video coder,

generating, via the video coder, a second quantizer estimate for the picture based on a linear regression of quantizer assignments made to prior pictures of a same type, actual coding rates achieved by such quantizer assignments and the target bitrate, and

selecting, via the video coder, a quantizer based on a difference between the two quantizer estimates and based on the estimate of the picture's complexity.

2. (Previously Presented) The rate control method of claim 1, wherein the estimate of the picture's complexity is determined by analyzing spatial complexity within the picture.

3. (Previously Presented) The rate control method of claim 1, wherein the estimate of the picture's complexity is determined by analyzing motion complexity of the picture with respect to previously coded pictures.

4. (Previously Presented) The rate control method of claim 1, wherein the estimate of the picture's complexity is determined by analyzing a number of bits used to represent each pixel in the picture.

5. (Original) The rate control method of claim 1, further comprising selectively canceling transform coefficients of coded blocks in the picture according to a rate control policy selected

for the picture.

6. (Original) The rate control method of claim 1, further comprising selectively canceling motion vectors of coded blocks in the picture according to a rate control policy selected for the picture.

7. (Original) The rate control method of claim 1, further comprising decimating pictures within the video sequence according to a rate control policy selected for the picture.

8. (Original) The rate control method of claim 1, further comprising selecting a coding mode for blocks of the picture according to a rate control policy selected for the picture.

9. (Original) The rate control method of claim 1, wherein the target bitrate is determined based on a number of bits (R) allocated to represent a group of pictures to which the picture belongs, a number (N) of like-kind pictures that will occur in the group of pictures.

10. (Original) The rate control method of claim 9, wherein when the picture is an I picture, the target bitrate T_i is determined by:

$$T_i = \max\left\{\frac{R}{\left(1+\frac{N_P X_P}{X_I K_P}+\frac{N_B X_B}{X_I K_B}\right)}, \frac{bitrate}{8 * picturerate}\right\}$$, where

R represents a number of bits allocated to code a group of pictures in which the I picture resides,

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the

group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

11. (Original) The rate control method of claim 9, wherein when the picture is a P picture, the target bitrate T_p is determined by:

$$T_P = \max\left\{\frac{R}{\left(N_P + \frac{N_B K_P X_B}{K_B X_P}\right)}, \frac{bitrate}{8 * picturerate}\right\}, \text{ where}$$

R represents a number of bits allocated to code a group of pictures in which the P picture resides,

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

12. (Original) The rate control method of claim 9, wherein when the picture is a B picture, the target bitrate T_b is determined by:

$$T_B = \max\left\{\frac{R}{\left(N_B + \frac{N_P K_B X_P}{K_P X_B}\right)}, \frac{bitrate}{8 * picturerate}\right\}, \text{ where}$$

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

13. (Original) The rate control method of claim 1, wherein when the picture is an I picture, the linear regression is performed using predetermined assumed values for the prior quantizer assignments and actual coding rates.

14. (Original) The rate control method of claim 1, wherein when the picture is an P picture, the linear regression is performed using quantizer assignments and actual coding rates for three prior P pictures.

15. (Original) A rate controller, comprising:

a scene content analyzer having an input for source video data and an output for complexity indicators representing complexity of each picture in the source video data,

a first quantizer estimator having an input for the source video data and complexity indicators, to generate a quantizer estimate of a picture based on a calculation of a target rate for coding the picture,

a second quantizer estimator having an input for the complexity indicators and past

values of quantizer selections and coding rates achieved therefrom, the second quantizer estimator to generate a second quantizer estimate for the picture based on a linear regression modeling of the prior quantizer selections and coding rates for like-kind pictures, and

a coding adapter, having inputs for the two quantizer estimates and the complexity indicators to select a quantizer for the picture based on a difference of the two quantizer estimates.

16. (Original) The rate controller of claim 15, wherein the coding adapter comprises a subtractor having inputs for the two quantizer estimates.

17. (Original) The rate controller of claim 15, wherein the coding adapter comprises:

a subtractor having inputs for the two quantizer estimates, and

a clipper coupled to an output of the subtractor.

18. (Original) The rate controller of claim 17, further comprising a divider coupled to the output of the clipper.

19. (Original) The rate controller of claim 17, further comprising a subtractor having a first input coupled to the output of the clipper and a second input for a value of a quantizer of a previously processed picture.

20. (Original) The rate controller of claim 15, wherein the coding adapter comprises a lookup table indexed by a complexity indicator representing complexity of the picture and the picture's coding type.

21. (Previously Presented) A method for identifying a scene change from a sequence of video data, comprising:

for a plurality of macroblocks of an input picture, computing, via a video coder, variances of a plurality of blocks therein,

comparing, via the video coder, minimum variance values of the plurality of macroblocks to corresponding minimum variance values of macroblocks from a prior picture,

calculating, via the video coder, an activity level of the input picture from the variances,

comparing, via the video coder, the activity level of the input picture to an activity level of the prior picture, and

generating, via the video coder, a scene change decision from the two comparisons.

22. (Original) The method of claim 21, wherein the comparison of minimum variance values comprises:

averaging the minimum variance values of each macroblock in the input picture,

averaging minimum variance values of each macroblock in the prior picture, and

comparing the average minimum variance values of the input picture to the average minimum variance values of the prior picture.

23. (Original) The method of claim 21, wherein the comparison of minimum variance values comprises:

averaging the minimum variance values of each macroblock in the input picture,

averaging minimum variance values of each macroblock in the prior picture,

normalizing each of the average minimum variance values, and

determining a ratio between the normalized values of the input picture to the normalized values of the prior picture, and

comparing the ratio to a predetermined threshold.

24. (Original) The method of claim 21, wherein the calculation of activity levels comprises:

averaging variances of all blocks in the picture, and

comparing the average variance value to the average minimum variance value for the picture.

25. (Original) The method of claim 21, wherein the comparison of activity levels comprises:

determining a ratio between the activity level of the input picture and the activity level of the prior picture, and

comparing the ratio to a predetermined threshold.

26. (Original) The method of claim 21, wherein the comparison of activity levels comprises:

normalizing activity levels for the input picture,

normalizing activity levels for the prior picture, and

comparing the normalized activity levels to each other.

27. (Previously Presented) A scene change detector, comprising:

a variance calculator to calculate a plurality of variance values for each macroblock in a source image,

a minimum variance selector to select a minimum variance value for each macroblock,

a memory to store minimum variance values of a previously processed image,

a comparator to compare the minimum variance values of the source image to the minimum variance values of the previously processed image,

an averager to calculate an average variance value for each macroblock,

an activity calculator to calculate an activity level of the source image from the average variance values, and

decision logic to signal a scene change based on a comparison of an output from the comparator and the activity level of the source image.

28. (Previously Presented) A computer-readable medium encoded with a set of instructions which, when performed by a computer, perform a rate control method, said method comprising, for a sequence of video data:

determining a target bitrate for a picture in the sequence based on an estimate of the picture's complexity,

generating a first quantizer estimate for the picture based on a fullness indicator from a

transmit buffer of a video coder,

generating a second quantizer estimate for the picture based on a linear regression of quantizer assignments made to prior pictures of a same type, actual coding rates achieved by such quantizer assignments and the target bitrate, and

selecting a quantizer based on a difference between the two quantizer estimates and based on the estimate of the picture's complexity.

29. (Previously Presented) The computer-readable medium of claim 28, wherein the estimate of the picture's complexity is determined by analyzing spatial complexity within the picture.

30. (Previously Presented) The computer-readable medium of claim 28, wherein the estimate of the picture's complexity is determined by analyzing motion complexity of the picture with respect to previously coded pictures.

31. (Previously Presented) The computer-readable medium of claim 28, wherein the estimate of the_picture's complexity is determined by analyzing a number of bits used to represent each pixel in the picture.

32. (Previously Presented) The computer-readable medium of claim 28, wherein the method further comprises selectively canceling transform coefficients of coded blocks in the picture according to a rate control policy selected for the picture.

33. (Previously Presented) The computer-readable medium of claim 28, wherein the method further comprises selectively canceling motion vectors of coded blocks in the picture according to a rate control policy selected for the picture.

34. (Previously Presented) The computer-readable medium of claim 28, wherein the method further comprises decimating pictures within the video sequence according to a rate control policy selected for the picture.

35. (Previously Presented) The computer-readable medium of claim 28, wherein the method further comprises selecting a coding mode for blocks of the picture according to a rate control policy selected for the picture.

36. (Previously Presented) The computer-readable medium of claim 28, wherein the target bitrate is determined based on a number of bits (R) allocated to represent a group of pictures to which the picture belongs, a number (N) of like-kind pictures that will occur in the group of pictures.

37. (Previously Presented) The computer-readable medium of claim 36, wherein when the picture is an I picture, the target bitrate T_i is determined by:

$$T_i = \max\left\{ \frac{R}{\left(1 + \frac{N_P X_P}{X_I K_P} + \frac{N_B X_B}{X_I K_B}\right)}, \frac{bitrate}{8 * picturerate} \right\}$$, where

R represents a number of bits allocated to code a group of pictures in which the I picture resides,

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

38. (Previously Presented) The computer-readable medium of claim 36, wherein when the picture is a P picture, the target bitrate T_p is determined by:

$$T_P = \max\left\{\frac{R}{\left(N_P + \frac{N_B K_P X_B}{K_B X_P}\right)}, \frac{bitrate}{8 * picturerate}\right\}, \text{ where}$$

R represents a number of bits allocated to code a group of pictures in which the P picture resides,

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

39. (Previously Presented) The computer-readable medium of claim 36, wherein when the picture is a B picture, the target bitrate T_b is determined by:

$$T_B = \max\left\{\frac{R}{\left(N_B + \frac{N_P K_B X_P}{K_P X_B}\right)}, \frac{bitrate}{8 * picturerate}\right\}, \text{ where}$$

N_P and N_B respectively represent the number of P and B pictures that appear in a group of frames,

X_I and X_P respectively represent complexity estimates for the I and P pictures in the group of frames,

K_P is a constant,

K_B is determined based on the complexity indicators,

bitrate represents the number of bits allocated for coding of the group of pictures, and

picturerate represents the number of pictures in the group of pictures.

40. (Previously Presented) The computer-readable medium of claim 28, wherein when the picture is an I picture, the linear regression is performed using predetermined assumed values for the prior quantizer assignments and actual coding rates.

41. (Previously Presented) The computer-readable medium of claim 28, wherein when the picture is an P picture, the linear regression is performed using quantizer assignments and actual coding rates for three prior P pictures.

42. (Previously Presented) A computer-readable medium encoded with a set of instructions which, when performed by a computer, perform a method for identifying a scene change from a sequence of video data, comprising:

for a plurality of macroblocks of an input picture, computing variances of a plurality of blocks therein,

comparing minimum variance values of the plurality of macroblocks to corresponding minimum variance values of macroblocks from a prior picture,

calculating an activity level of the input picture from the variances,

comparing the activity level of the input picture to an activity level of the prior picture, and

generating a scene change decision from the two comparisons.

43. (Previously Presented) The computer-readable medium of claim 42, wherein the

comparison of minimum variance values comprises:

averaging the minimum variance values of each macroblock in the input picture,

averaging minimum variance values of each macroblock in the prior picture, and

comparing the average minimum variance values of the input picture to the average minimum variance values of the prior picture.

44. (Previously Presented) The computer-readable medium of claim 42, wherein the comparison of minimum variance values comprises:

averaging the minimum variance values of each macroblock in the input picture,

averaging minimum variance values of each macroblock in the prior picture,

normalizing each of the average minimum variance values, and

determining a ratio between the normalized values of the input picture to the normalized values of the prior picture, and

comparing the ratio to a predetermined threshold.

45. (Previously Presented) The computer-readable medium of claim 42, wherein the calculation of activity levels comprises:

averaging variances of all blocks in the picture, and

comparing the average variance value to the average minimum variance value for the picture.

46. (Previously Presented) The computer-readable medium of claim 42, wherein the comparison of activity levels comprises:

determining a ratio between the activity level of the input picture and the activity level of the prior picture, and

comparing the ratio to a predetermined threshold.

47. (Previously Presented) The computer-readable medium of claim 42, wherein the comparison of activity levels comprises:

normalizing activity levels for the input picture,

normalizing activity levels for the prior picture, and

comparing the normalized activity levels to each other.